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I thank the members of the Committee for inviting me to speak about research that may be relevant to your deliberations about proposed bills to limit application of phosphorus-containing lawn fertilizers to turf grass in our state. I will limit my prepared remarks in order to permit sufficient time for questions and answers. I am providing you with a handout that contains recent publications from my research group on this subject as well as a list of media outlets across the nation that have carried accounts of our recent research results.

This year marks the 47th anniversary of a landmark publication by the American Society of Limnology and Oceanography called *Nutrients and Eutrophication*. The publication reported the state of scientific knowledge about the relationship between plant mineral nutrients and excessive production of aquatic plant life in the Great Lakes and inland waters. Particular emphasis was given in that publication to the role of phosphate in the overproduction of nuisance, harmful, or toxic algal blooms. Within a decade great strides were being made by the nascent U.S. EPA and state governments to limit the discharges of phosphate from wastewater treatment facilities and industrial sources that could be identified as so-called "point" sources. The notable improvements achieved through those efforts are conspicuous today in lakes world-wide, including Lake Zurich, Switzerland, Lago Maggiore, Italy, Lake Washington at Seattle, and the upper Great Lakes of North America.

Unfortunately, some of our inland waters have proved intransigent to point source controls. There are additional pathways that supply phosphate to our surface waters. One of these is internal release of phosphate from lake mud under specific environmental conditions. The other is a more diffuse release from watershed sources known as "non-point" sources. These may include erosion and runoff from construction sites or other bare ground as well as from urban and residential neighborhoods.

For more than a decade, scientists and environmental planners have debated the contribution to non-point source phosphate pollution that might result from excessive or non-essential over-application of phosphorus fertilizer to turf grass. Since the 19th Century it has been known to agricultural science that the most common major nutrients that can limit agricultural plant production are nitrogen, phosphorus, and potassium. However, it is also known that the chemistry of native soils varies greatly, and that all three of the elements are rarely, if ever, in simultaneous short supply. That is particularly true in growth regimes where the plant tissue is not harvested as a commodity, but rather is allowed to decay and remineralize in place, thereby returning the elements to the soil.

It so happens that the soils of Michigan and some of its neighboring Great Lakes states are adequately endowed with phosphate to support the growth of turf grass and other ground cover without need of regular phosphate amendments. In recognition of this fact, the City of Ann Arbor enacted an ordinance that was intended to restrict application of phosphate fertilizers for non-agricultural use unless soil tests demonstrated the need. But immediately there arose questions about the efficacy of these regulatory measures. In particular, there was the question of whether there would be any demonstrable environmental response to the well-intentioned effort.

The great problem that has plagued previous attempts to measure the effect of management efforts on aquatic ecosystems has been that of "natural variability." Stream water concentrations of nutrients and other chemicals change from day to day and week to week even without human intervention. Existence of powerful, data-rich documentation of the baseline or reference conditions is essential in order to judge departures from past conditions with confidence.

We were in the right place at the right time, but not by design. My students and I had conducted a careful study of the Huron River from 2003 to 2005 that included measurements of phosphorus and other minerals upstream, downstream, and within the city limits of Ann Arbor at weekly and sub-weekly intervals. The study was part of research sponsored by the U.S. EPA aimed at identifying and correcting the nuisance algal blooms that plagued Ford Lake each summer. So when Matt Naud, Ann Arbor's environmental coordinator, phoned me and asked if it would be possible to detect a reduction of perhaps 22 percent in phosphorus load, we were in a unique position to evaluate the feasibility of such a challenge. I won't review the logic and methods we used, because they are documented in the handouts.

I am pleased to report that our findings withstood vigorous peer review by three independent expert referees, and in the end were lauded by the journal editor as being at the vanguard of one of the "hot topics of the decade" in aquatic environmental management. That said, I need to condition our findings. After Ann Arbor implemented its ordinance, we measured a 28 percent decline in the phosphorus content of the Huron River. The decline is factual and reproducible. Results from 2009, this summer, are confirmatory to our results from 2008. But whether that drop was caused by compliance with the ordinance or to some other cause cannot be proven affirmatively. We, and our peer referees, sought to disprove that theory, but so far we have not been able to reject it as being valid. Therefore we are justified to continue with our working hypothesis—that reduced application of phosphorus fertilizer is having a salutary effect—until, or if, concrete evidence emerges to refute that idea.